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INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 97/00019

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H04L 12/56, H04L 12/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 9522230 A2 (TELEFONAKTIEBOLAGET LM ERICSSON), 17 August 1995 (17.08.95), page 3, line 1 - line 23; page 6, line 22 - line 25, figures 5,8 ---	1-10
A	US 5103475 A (SHUEN), 7 April 1992 (07.04.92), column 5, line 53 - line 61; column 6, line 45 - line 68 ---	6
A	US 4640986 A (YOTSUTANI ET AL), 3 February 1987 (03.02.87), see the whole dokument ---	1-10

 Further documents are listed in the continuation of Box C. See patent family annex.

- * Special categories of cited documents:
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- "B" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

Date of the actual completion of the international search

Date of mailing of the international search report

24 March 1997

26.04.1997

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INTERNATIONAL SEARCH REPORT
Information on patent family members

04/03/97

International application
PCT/FI 97/00015

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
WO 9522230 A2	17/08/95	AU 1721795 A		29/08/95
		CN 1124556 A		12/06/96
		EP 0692174 A		17/01/96
		FI 954659 A		29/09/95
US 5103475 A	07/04/92	CA 2050400 A,C		30/04/92
US 4640986 A	03/02/87	AU 577732 B		29/09/88
		AU 3304784 A		21/03/85
		CA 1227249 A		22/09/87
		DE 3484913 A		19/09/91
		EP 0135196 A,B		27/03/85
		SE 0135196 T3		
		JP 60062741 A		10/04/85
		JP 1614024 C		15/08/91
		JP 2026897 B		13/06/90
		JP 60062744 A		10/04/85

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

19

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 42882/PCT/nu	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/FI97/00019	International filing date (<i>day/month/year</i>) 14.01.1997	Priority date (<i>day/month/year</i>) 15.01.1996
International Patent Classification (IPC) or national classification and IPC6 H 04 L 12/56, H 04 L 12/14		
Applicant NOKIA TELECOMMUNICATIONS OY ET AL.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 4 sheets, including this cover sheet.

This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of _____ sheets.

3. This report contains indications relating to the following items:

- I Basis of the report
- II Priority
- III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV Lack of unity of invention
- V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability, citations and explanations supporting such statement
- VI Certain documents cited
- VII Certain defects in the international application
- VIII Certain observations on the international application

Date of submission of the demand 13.06.1998	Date of completion of this report 21.04.1998
Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. 08-667 72 88	Authorized officer Jan Silfverling Telephone No. 08-782 25 00

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/FI97/00019

I. Basis of the report

1. This report has been drawn on the basis of (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

 the international application as originally filed. the description, pages _____, as originally filed,

pages _____, filed with the demand,

pages _____, filed with the letter of _____,

pages _____, filed with the letter of _____

 the claims, Nos. _____, as originally filed,

Nos. _____, as amended under Article 19,

Nos. _____, filed with the demand,

Nos. _____, filed with the letter of _____,

Nos. _____, filed with the letter of _____

 the drawings, sheets/fig _____, as originally filed,

sheets/fig _____, filed with the demand

sheets/fig _____, filed with the letter of _____,

sheets/fig _____, filed with the letter of _____

2. The amendments have resulted in the cancellation of:

 the description, pages _____ the claims, Nos. _____ the drawings, sheets/fig _____

3. This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the supplemental Box (Rule 70.2(c)).

4. Additional observations, if necessary:

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/FI97/00019

V. Resoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	<u>1-10</u>	YES
	Claims	_____	NO
Inventive step (IS)	Claims	_____	YES
	Claims	<u>1-10</u>	NO
Industrial applicability (IA)	Claims	<u>1-10</u>	YES
	Claims	_____	NO

2. Citations and explanations

The invention relates to a packet radio network where charging information is collected by support nodes (SGSN, GGSN) and forwarded to billing centres. A billing centre comprises a billing gateway support node (BGGSN) and a charging system. The user-specific charging information collected by the other support nodes, is received by the billing gateway support node (BGGSN) and forwarded to the charging system.

The international search revealed among others the following relevant document:

D1. WO 95/22230 A2

D1 discloses a method and an apparatus for identifying call records in a radio telephone communication network. The call records are produced in different nodes. A post processing system collects the call records and produces one bill based on the information in them (see figure 5). The call records may contain codes which are useful in distinguishing between different communication systems and protocols. The post processing system is connected to the different nodes through data links.

In the written opinion, the following arguments and statements were presented: There is a possible difference between the functions of a) the BGGSN and the charging system in claim 1, and b) the post processing system in D1. Also, there is no corresponding information about the post processing system in D1 when it comes to the different kinds of addresses of the BGGSN, defined in claim 7 - 10. However, these differences are of minor importance as they are considered to be obvious for the expert in the matter.

In your answer to the written opinion, you stress the following differences between D1 and the application: D1 has nothing to do with packet radio systems and particularly not with charging in packet radio systems. Also, you point out that the communications between the mobile exchanges and the post processing system are provided with dedicated data links.

.../...

INTERNATIONAL PRELIMINARY EXAMINATION REPORTInternational application No.
PCT/FI97/00019**Supplemental Box**

(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: Box V.

D1 shows a method for charging calls in a cellular telephone network. However, it is considered obvious for a man skilled in the art that this technique could be used in a packet radio network. In claim 1, it says that the billing gateway support node (BGSN) is connected to the network, that it receives user specific charging information collected by other support nodes (SGSN, GGSN), and that it forwards the charging information to the charging system. In D1 the call records are collected by nodes and transferred through data links to the postprocessing system where a bill is produced. The kind of data links to be used is regarded as a supplementary detail. It is considered obvious for a man skilled in the art to use an appropriate kind of data links. The general idea of the invention, defined by claims 1-10, are not considered to differ substantially from D1. Therefore, claims 1-10 do not disclose an inventive step.

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- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed
- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
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Date of the actual completion of the international search

24 March 1997

Date of mailing of the international search report

26.04.1997

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INTERNATIONAL SEARCH REPORT
Information on patent family members

04/03/97

International application No.

PCT/FI 97/00019

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
WO 9522230 A2	17/08/95	AU 1721795 A		29/08/95
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		SE 0135196 T3		
		JP 60062741 A		10/04/85
		JP 1614024 C		15/08/91
		JP 2026897 B		13/06/90
		JP 60062744 A		10/04/85

PATENT COOPERATION TREATY

PCT

NOTICE INFORMING THE APPLICANT OF THE
COMMUNICATION OF THE INTERNATIONAL
APPLICATION TO THE DESIGNATED OFFICES

(PCT Rule 47.1(c), first sentence)

From the INTERNATIONAL BUREAU

To:

KOLSTER OY AB
Iso Roobertinkatu 23
P.O. Box 148
FIN-00121 Helsinki
FINLANDE

E 1 -08- 1997

Date of mailing (day/month/year) 24 July 1997 (24.07.97)		
Applicant's or agent's file reference 42882/PCT/ko	IMPORTANT NOTICE	
International application No. PCT/FI97/00019	International filing date (day/month/year) 14 January 1997 (14.01.97)	Priority date (day/month/year) 15 January 1996 (15.01.96)
Applicant NOKIA TELECOMMUNICATIONS OY et al		

1. Notice is hereby given that the International Bureau has communicated, as provided in Article 20, the international application to the following designated Offices on the date indicated above as the date of mailing of this Notice:
AU, BR, CA, CN, DE, EP, IL, JP, KP, KR, NO, PL, RO, SK, US

In accordance with Rule 47.1(c), third sentence, those Offices will accept the present Notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

2. The following designated Offices have waived the requirement for such a communication at this time:
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The communication will be made to those Offices only upon their request. Furthermore, those Offices do not require the applicant to furnish a copy of the international application (Rule 49.1(a-bis)).

3. Enclosed with this Notice is a copy of the international application as published by the International Bureau on 24 July 1997 (24.07.97) under No. WO 97/26739

REMINDER REGARDING CHAPTER II (Article 31(2)(a) and Rule 54.2)

If the applicant wishes to postpone entry into the national phase until 30 months (or later in some Offices) from the priority date, a demand for international preliminary examination must be filed with the competent International Preliminary Examining Authority before the expiration of 19 months from the priority date.

It is the applicant's sole responsibility to monitor the 19-month time limit.

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

REMINDER REGARDING ENTRY INTO THE NATIONAL PHASE (Article 22 or 39(1))

If the applicant wishes to proceed with the international application in the national phase, he must, within 20 months or 30 months, or later in some Offices, perform the acts referred to therein before each designated or elected Office.

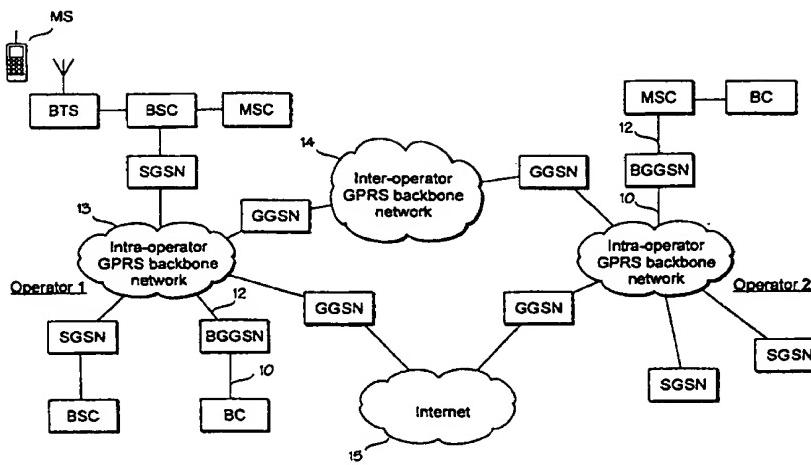
For further important information on the time limits and acts to be performed for entering the national phase, see the Annex to Form PCT/I8/301 (Notification of Receipt of Record Copy) and Volume II of the PCT Applicant's Guide.

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer J. Zahra
Facsimile No. (41-22) 740.14.35	Telephone No. (41-22) 338.83.38

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : H04L 12/56, 12/14		A1	(11) International Publication Number: WO 97/26739
			(43) International Publication Date: 24 July 1997 (24.07.97)
(21) International Application Number: PCT/FI97/00019		(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).	
(22) International Filing Date: 14 January 1997 (14.01.97)			
(30) Priority Data: 960185 15 January 1996 (15.01.96) FI			
(71) Applicant (for all designated States except US): NOKIA TELECOMMUNICATIONS OY [FI/FI]; Keilalahdentie 4, FIN-02150 Espoo (FI).			
(72) Inventors; and			
(75) Inventors/Applicants (for US only): KARI, Hannu, H. [FI/FI]; Kullervonkuja 9 B 9, FIN-02880 Veikkola (FI). HÄMÄLÄINEN, Jari [FI/FI]; Matti Tapionkatu 1 F 17, FIN-33720 Tampere (FI).			
(74) Agent: KOLSTER OY AB; Iso Roobertinkatu 23, P.O. Box 148, FIN-00121 Helsinki (FI).			

(54) Title: PACKET RADIO NETWORK WITH CHARGING INFORMATION COLLECTED BY NODES AND FORWARDED TO BILLING CENTRE



(57) Abstract

In a digital mobile communication system, a packet radio system has been implemented by employing the radio interface of the mobile communication network. The packet radio system comprises packet radio support nodes (SGSN) connected to the mobile communication network, as well as gateway support nodes for providing an inter-connection to an external packet data network (15). The support nodes (SGSN, GGSN) are connected to an intra-operator packet switched backbone network (13). The serving support nodes and the gateway support nodes collect charging information on usage of the radio interface and the data network (15), respectively. The system is further provided with a billing gateway support node (BGGSN) connected to the internal backbone network (BGGSN) to receive user-specific charging information collected by the other support nodes, and to forward the charging information to a charging system.

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GA	Gabon			VN	Viet Nam

a packet data service via a multitude of base stations i.e. cells. The mobile communication network in between offers a packet switched data transfer between the support node and the mobile data terminal equipments. The 5 different subnetworks, in turn, are connected to an external data network, e.g. to a packet switched public data network PSPDN, via specific gateway GPRS support nodes, GGSN. Thus, the GPRS service provides packet data transfer between mobile data terminal equipments and 10 external data networks with the GSM network serving as an access network. One of the features of the GPRS service network is that it operates almost independently of the GSM network with the "conventional" GSM network services.

One of the problems is how to carry out charging in 15 the GPRS network. User-related data transmission statistics, used for charging the user, are normally gathered at the serving GPRS support nodes SGSN and at the gateway GPRS support nodes GGSN. The SGSN collects information about the radio interface usage and the GGSN 20 collects information about the data network usage. The number of SGSNs and GGSNs in an MSC service area can be quite high, tens or even hundreds of nodes. However, no suggestions exist as to how to carry out charging using such scattered charging information. In the GSM mobile 25 communication network, the billing records (Call Detailed Records) are typically generated at the mobile communication network or in an Intelligent Network IN coupled thereto. However, there are no direct interfaces from the GPRS system to the mobile network or the IN 30 suitable also for the GPRS charging. A further problem is that the billing centers and the interfaces they use have not been standardized even in the mobile communication networks and are consequently different for every operator. This would require implementing different 35 interfaces in different GPRS networks. Similar problems

PACKET RADIO NETWORK WITH CHARGING INFORMATION COLLECTED BY NODES AND FORWARDED TO BILLING CENTRE

Field of the Invention

5 The present invention relates to packet radio networks and particularly to carrying out charging in packet radio networks.

Background of the Invention

10 Mobile communication systems have been developed in order to make people free to move away from fixed telephone terminals without, however, making them more difficult to reach. With an increasing usage of data transfer services in offices, various kinds of data services have been introduced to the mobile communication systems as well. Portable computers enable efficient data processing wherever the user may be. Mobile communication networks, in turn, provide users with an efficient access network for mobile data transfer, the access network providing access to actual data networks. For this purpose, various new forms of data service are being 15 planned in present and future mobile communication networks. Mobile data transfer is particularly well supported by digital mobile communication systems, such as the Pan-European mobile communication system, GSM (Global System for Mobile Communication).

20 25 A new service in the GSM system is provided by GPRS (General Packet Radio Service), which is one of the topics for GSM stage 2+ standardization work being done in ETSI (European Telecommunication Standard Institute). The GPRS operational environment is constituted by one or more subnetwork service areas which are inter-connected by a GPRS Backbone Network. The subnetwork comprises a group of 30 packet data service nodes SN, herein referred to as serving GPRS support nodes SGSN, each of which is connected to the GSM mobile communication network so that 35 it is able to provide mobile data terminal equipments with

networks controlled by different operators. The transmitting support node only needs to know the address of the receiving support node. Between the support nodes that collect charging information and the BGGSNs, a communication protocol can be determined which is independent of the implementation of the operator's charging system, and the same in all the packet radio networks. In case the support node collecting charging information wishes to transmit charging information of a specific subscriber, it transmits the information to a specific billing gateway GPRS support node which forwards the charging information, either directly or indirectly, to the operator's charging system.

The communication protocol between the billing gateway GPRS support node and the operator's billing system may be operator-specific. The other support nodes in the packet radio network, however, need not know the implementation of this interface as the interface between the support nodes and the billing gateway GPRS support node is standard.

The invention provides a number of advantages. In the packet radio network, only one charging interface is determined. Charging in the packet radio network is standardized, but it is not restricted to one embodiment or charging system communication protocol. The operator only needs one interface for the charging system, and not e.g. a dedicated interface in every support node. The operator may send charging information directly to another operator, from one billing gateway GPRS support node to another.

Brief Description of the Drawings

In the following, the invention will be described by means of its preferred embodiments, with reference to the attached drawing in which the GPRS system according to the invention is shown.

may also occur in other packet radio networks of the GPRS network type.

Brief Summary of the Invention

It is object of the present invention to enable
5 billing in packet radio networks.

A further object of the present invention is a charging information collecting system which is independent of the billing system implementation in a packet radio network.

10 The invention relates to a packet radio system comprising a digital mobile communication network; packet data terminal equipments; packet radio support nodes connected to the mobile communication network which provides them with a radio interface for packet switched data transmission with the packet data terminal equipments; gateway packet radio support nodes providing an access point to an external packet data network; and an internal packet switched backbone network to which the packet radio support nodes and the gateway packet radio support nodes are connected. The packet radio network according to the invention further comprises a billing gateway support node, which is connected to said internal backbone network to receive user-specific charging information collected by other support nodes and to forward the charging information to the billing system.

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The basic idea of the invention is to provide the internal backbone network of the packet radio network with a new support node establishing a gateway from the packet radio network to the actual billing system. This support node is herein referred to as a billing gateway GPRS support node BGGSN. As the BGGSN is connected to the packet switched backbone network within the packet data network, it is possible to exchange information between the BGGSN and any other support node in the packet radio system, even in case the nodes are in packet radio

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support and gateway nodes..

In a cellular packet radio network, each support node SGSN controls a packet data service within the area of one or more cells. For this purpose, each support node 5 SGSN is connected to a specific local part of the GSM mobile communication system. This connection is typically to the mobile services switching center, but in some cases it might prove advantageous to make the connection directly to the base station system BSS, in other words, 10 to the BSC or one of the base stations BTS. A mobile station MS in a cell communicates over the radio interface with the base station BTS and further, via the mobile communication network, with the support node SGSN in whose 15 service area the cell is located. In principle, the mobile communication network between the support node SGSN and the mobile station MS may forward packets between these two. For this purpose, the mobile communication network may offer either a circuit switched connection or a packet 20 switched data packet transfer scheme between the mobile station MS and the serving support node SGSN. An example of a circuit switched connection between a mobile station MS and a support node (Agent) is disclosed in the Finnish patent application 934115. An example of a packet switched data transfer between a mobile station MS and a support 25 node (Agent) is disclosed in the Finnish patent application 940314. However, it should be noted that the mobile communication network only provides a physical connection (access network) between the MS and the SGSN, and its exact operation or structure have no relevance to 30 the present invention.

The intra-operator backbone network 13, which interconnects the apparatuses SGSN and GGSN of the operator, may be implemented e.g. by a local area network, such as an IP network, a CLNP network or an X.25 network. 35 It should be noted that an operator's GPRS network may

The present invention is applicable to different types of packet radio systems in which support nodes are connected by a common backbone network. The invention is particularly well applicable to implementing a General 5 Packet Radio Service (=GPRS) in the Pan-European digital mobile communication system GSM (Global System For Mobile Communication) or similar mobile communication systems, such as the DCS1800 and the PCS (Personal Communication System). Below, the preferred embodiments of the invention 10 will be described by means of a GPRS packet radio network, which is a combination of the GPRS service and the GSM system, without, however, restricting the invention to such a specific packet radio system.

The figure illustrates a GPRS packet radio network 15 implemented in the GSM system.

The basic structure of the GSM network consists of two parts: a base station system BSS and a network subsystem NSS. The BSS and mobile stations MS communicate through radio connections. Within the BSS each cell is 20 served by a base station BTS. A number of base stations is connected to a base station controller BSC whose function is to control radio frequencies and channels used by the BTS. The BSCs are connected to a mobile services switching center MSC. For a more detailed description of the GSM 25 system, reference is made to the ETSI/GSM recommendations and "The GSM System for Mobile Communications", M. Mouly and M. Pautet, Palaiseau, France, 1992, ISBN:2-9507190-07-7.

In the figure, the GPRS system connected to the GSM 30 system comprises two GPRS operators; operator 1 and operator 2, both having two serving GPRS support nodes (SGSN) and a gateway GPRS support node (GGSN). The different support nodes SGSN and GGSN are interconnected by an Intra-Operator Backbone Network. It should be 35 understood that the GPRS network may have any number of

GGSN also comprises a database which maps together the network address of the mobile station, e.g. in the IP, X.25, or CLNP network, or simultaneously in a plurality of them, and the GPRS roaming identity of the mobile station in the GPRS network.

User-related data transfer statistics, used for charging the user, are also collected mainly at the serving GPRS support nodes SGSN, and in the gateway GPRS support nodes GGSN. The SGSN collects information about the radio interface usage and the GGSN collects information about the data network usage. Typically, charging in the packet radio system consists of subscriber fees and traffic fees. The subscriber fee is a regular payment paid by the subscribers to cover a specific period of time. The traffic fees are typically determined in a packet radio network as a function of data amount and service type, possibly service quality as well. The data amount measuring techniques may include simply counting the bytes or an advanced statistical sampling of the data traffic. In principle, charging for usage of a packet radio network should be possible the same way as in general packet switched data networks. The exact charging basis may be operator-specific. The charging principles are not significant as far as the present invention is concerned, because it is generally applicable to different charging methods.

The operator's billing system, which carries out the final subscriber billing on the basis of the charging information collected, may be located freely as it is not a part of the actual packet radio network. In the example of the figure, the charging system is placed apart from the actual packet radio network in a specific charging center BC. Alternatively, it may be situated e.g. at the MSC. The exact implementation of the charging center BC may vary operator-specifically. The exact implementation

also be implemented without an intra-operator backbone network, for example by implementing all the features in one and the same computer; such an alteration does not change the charging principles of the invention.

5 The gateway GPRS support node GGSN connects the operator's GPRS network to the GPRS systems of other operators and to data networks 15, such as an Inter-Operator Backbone Network, an IP network (Internet) or an X.25 network.

10 The inter-operator backbone network is a network through which the GGSNs of different operators may communicate with one another. This communication is required to support GPRS roaming between different GPRS networks. The inter-operator backbone network may be 15 implemented by using e.g an X.25, IP, CLNP or other networks as long as the GGSN of both sides employ the same protocols toward the backbone network between the operators. To take an example, if the intra-operator network is an IP network, an operator 1 may have an 20 internal X.25 network (in the intra-backbone network of operator 1), and an operator 2 may have an internal CLNP network (in the intra-backbone network of operator 2). In such a case, the GPRS GSN of the operator 1 should use 25 X.25 protocol locally and the IP protocol toward the inter-operator backbone network. Similarly, the GPRS GSN of the operator 2 should use the CLNP protocol locally and the IP protocol toward the inter-operator backbone network. It should be noted that if the networks of both 30 the operators and the network in between all use the same protocol, the GGSNs between them is not necessarily required but they may be replaced by e.g. data network bridges or routers.

35 The gateway GPRS support node GGSN is also used for storing location information of GPRS mobile stations. The GGSN also routes mobile-terminating (MT) data packets. The

but the invention is generally applicable to all the protocols. The BGGSN may also buffer, combine or pre-process the charging information in some other way before sending it to the BC.

5 The BGGSN address to which other support nodes send charging information may be either fixed or dynamic. In the former case, the support node SGSN or GGSN always sends the charging information to the same BGGSN whose address is permanently stored in the support node. In the
10 latter case, the BGGSN to which the charging information is sent varies e.g. according to the service type or subscriber. In case the address varies according to subscribers, the address of the correct BGGSN is given to the support node when the subscriber begins to use a GPRS
15 service. The BGGSN to which the support node sends the charging information may be within the network of the same or a different operator. For example, the SGSN in the network controlled by the operator 1 may send charging information to the BGGSN of the same network, when the
20 subscriber's home network is the network of the operator 1. However, the same SGSN may also send charging information to the BGGSN of the operator 2, when the home network of the subscriber 2 is the network controlled by the operator 2 and the subscriber is roaming in the
25 network of the operator 1. In such a case, a data packet containing the charging information is routed from one network to another the same way as other data packets. In a similar manner, the BGGSNs (and consequently BCs) of different operators may also exchange information by
30 sending data packets from one network to another via the inter-operator backbone network or data network. It is also possible that the SGSN sends the charging information to the BGGSN of the operator 1, even if the home network of the subscriber 2 is the network controlled by the
35 operator 2 and the subscriber is roaming in the network of

of the BC is not essential to the present invention, because it is generally applicable to different charging centers.

The internal backbone network of the packet radio network according to the invention is provided with a new support node, which provides a gateway from the packet radio network to the actual charging system, such as the charging center BC. This support node is herein referred to as a billing gateway GPRS support node BGGSN. As the BGGSN is connected to the intra-operator packet switched backbone network, it is possible to exchange information between the BGGSN and any other support node SGSN or GGSN in the packet radio network, even if the nodes are in packet radio networks of different operators. The transmitting support node only need to know the address of the receiving support node. Between the support nodes SGSN or GGSN that collect charging information and the BGGSNs there exists a communication protocol which is independent of the implementation of the operator's charging system, and the same in all the packet radio networks. In case the SGSN or GGSN collecting charging information wishes to transmit charging information of a specific subscriber (identified with e.g. an international mobile subscriber identity IMSI in the GPRS system) to the charging center BC, it transmits the information in data packets corresponding to the protocol (e.g. IP) of the backbone network, the data packets containing the network address (e.g. IP address) of a specific BGGSN. The data field of the data packet may contain the charging information in a suitable format. The data field may contain subfields which contain the IMSI, data amount and the service type. The BGGSN receiving the data packet forwards the charging information to the operator's charging center BC. The exact implementation of the protocol used in the charging information transfer is not essential to the invention,

the operator 1 (the visitor network).

The BGGSN may be connected to the BC either directly (as the operator 1 BGGSN connection 12 in the figure), or indirectly via an intermediate network (such 5 as an intelligent network IN) or a network element (as the operator 2 BGGSN connection 12 in the figure). The connection and communication protocol between the BGGSN and the operator's charging center BC may be operator-specific. It may be based e.g. on SS7 (Signalling System 10 7) employed by e.g. the GSM system. The connection and the communication protocol are not significant as far as the invention is concerned, as the invention is meant to be generally applicable to all the solutions.

The description is only intended to illustrate the 15 preferred embodiments of the present invention. The invention is not to be restricted to these examples, but it may be modified within the scope of the attached claims.

Claims

1. A packet radio system comprising:
a digital mobile communication network (BTS, BSC,
5 MSC) ;
packet data terminal equipments (MS) ;
packet radio support nodes (SGSN) connected to the
mobile communication network which provides them with a
radio interface for packet switched data transmission with
10 the packet data terminal equipments;
gateway packet radio support nodes (GGSN) providing
an access point to an external packet data network (15) ;
and
an internal packet switched backbone network (13)
15 to which the packet radio support nodes (SGSN) and the
gateway packet radio support nodes (GGSN) are connected,
characterized by
a billing gateway support node (BGGSN) , connected
to said internal backbone network (BGGSN) to receive user-
20 specific charging information collected by the other
support nodes (SGGSN, GGSN) and to forward the charging
information to the charging system.
2. A method as claimed in claim 1,
25 characterized in that the communication
protocol between the billing gateway support node (BGGSN) ,
the packet radio support nodes (SGGSN) and the gateway
packet radio support nodes (GGSN) is a packet switched
communication protocol of said internal backbone network.
3. A method as claimed in claim 1 or 2,
30 characterized in that the communication
protocol between the billing gateway support node (BGGSN) ,
the packet radio support nodes (SGGSN) and the gateway
packet radio support nodes (GGSN) is independent of a
communication protocol between the gateway support node
35 and the charging system.

4. A packet radio network as claimed in claim 1, 2 or 3, characterized in that the communication protocol between the billing gateway support node (BGGSN) and the charging system is different from a packet switched communication protocol of said internal backbone network.

5 5. A packet radio network as claimed in any one of the previous claims, characterized in that the billing gateway support node (BGGSN) is provided with a direct connection to the billing system.

10 6. A packet radio network as claimed in any one of claims 1-5, characterized in that the billing gateway support node (BGGSN) is connected to the billing system via an intermediate network, such as an intelligent network, or via an intermediate network element, such as a mobile services switching center (MSC).

15 7. A packet radio network as claimed in any one of the previous claims, characterized in that the address of the billing gateway support node (BGGSN) to which the other support nodes send charging information is fixed.

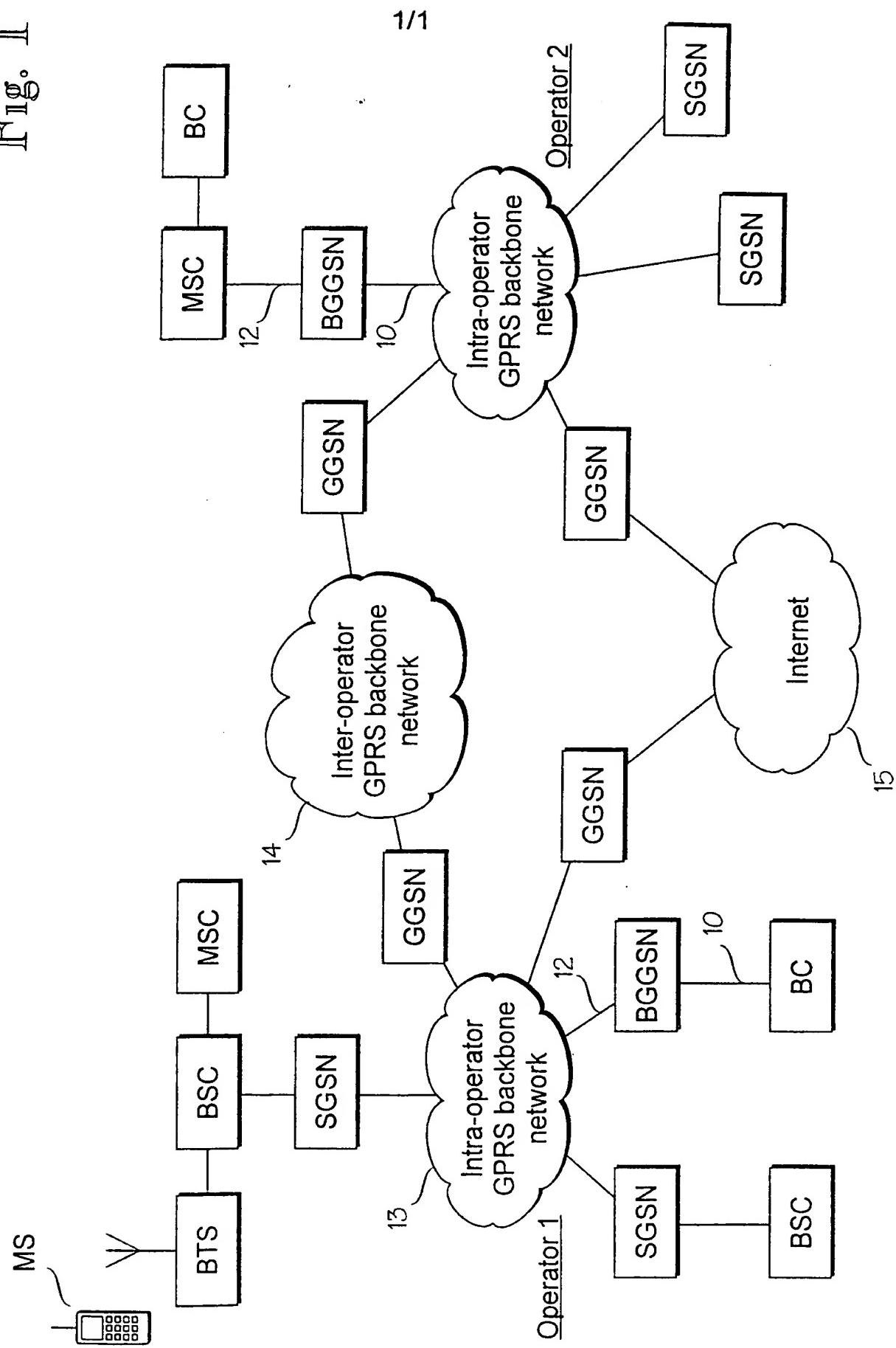
20 8. A packet radio network as claimed in any one of claims 1-6, characterized in that the address of the billing gateway support node (BGGSN) to which the other support nodes send charging information is dynamic.

25 9. A packet radio network as claimed in claim 8, characterized in that the address of the billing gateway support node (BGGSN) to which the other support nodes send charging information is subscriber-specific and is given to the respective other support node when the subscriber begins using a service.

30 10. A packet radio network as claimed in claim 8 or 9, characterized in that the support nodes are arranged to send the charging information to the billing gateway support node (BGGSN) of the subscriber's home

network or the visited network.

Fig. 1



INTERNATIONAL SEARCH REPORT
Information on patent family members

04/03/97

International application No.	
PCT/FI 97/00019	

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
WO 9522230 A2	17/08/95	AU 1721795 A CN 1124556 A EP 0692174 A FI 954659 A		29/08/95 12/06/96 17/01/96 29/09/95
US 5103475 A	07/04/92	CA 2050400 A,C		30/04/92
US 4640986 A	03/02/87	AU 577732 B AU 3304784 A CA 1227249 A DE 3484913 A EP 0135196 A,B SE 0135196 T3 JP 60062741 A JP 1614024 C JP 2026897 B JP 60062744 A		29/09/88 21/03/85 22/09/87 19/09/91 27/03/85 10/04/85 15/08/91 13/06/90 10/04/85

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 97/00019

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H04L 12/56, H04L 12/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 9522230 A2 (TELEFONAKTIEBOLAGET LM ERICSSON), 17 August 1995 (17.08.95), page 3, line 1 - line 23; page 6, line 22 - line 25, figures 5,8 ---	1-10
A	US 5103475 A (SHUEN), 7 April 1992 (07.04.92), column 5, line 53 - line 61; column 6, line 45 - line 68 ---	6
A	US 4640986 A (YOTSUTANI ET AL), 3 February 1987 (03.02.87), see the whole dokument -- -----	1-10

 Further documents are listed in the continuation of Box C. See patent family annex.

- * Special categories of cited documents:
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- "Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

Date of the actual completion of the international search

Date of mailing of the international search report

24 March 1997

26.04.1997

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